the e&s

STUDENT PERSPECTIVES ON ENGINEERING AND SCIENCE

WINTER 2019 VOLUME 63 NUMBER 2

THE INNOVATION ISSUE

Feature: The "Why" Behind Innovation

LOUISIANA TECH UNIVERSITY

DEAN'S CORNER

Designing and Building the Engineer & Scientist of 2020

By Hisham Hegab, Dean, College of Engineering & Science

Over 17 years ago, the National Academy of Engineering published a report on the Engineer of 2020 that listed several key attributes that new engineering graduates will need to be successful. These attributes include strong analytical skills, practical ingenuity, creativity, communication and life-long learning skills, adaptability, high ethical standards, leadership, professionalism and business/ management abilities. I believe what makes the combination of these attributes significant is that they are skills and characteristics that allow a person to be innovative. As our graduates now compete in a global market place, one crucial ability that will set them apart from the competition is the ability to innovate.

As we quickly approach 2020, I believe the College of Engineering and Science continues designing and building its program curricula as well as our educational environment and extra-curricular experiences to produce innovative engineering and science graduates. The latest effort toward this objective is under construction near our existing facilities of Bogard, Nethken and Carson-Taylor Halls. The new Integrated Engineering and Science Education Building incorporates many features to help support the development of the Engineer of 2020 attributes, such as flexible classroom-to-lab spaces that can be rearranged to support the best learning pedagogies. The building includes a student achievement center to provide direct student access to the latest prototyping equipment. It houses collaboration spaces with audio and visual technology to support teams of students working together on homework and projects, and, most importantly, it contains a coffee spot to provide the caffeine to fuel the innovation. Our faculty, staff and students eagerly anticipate the opening of this new facility in the Fall of 2019. I hope you will enjoy this issue of the E&S and stop by for a tour and some coffee next fall.

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STUDENT PERSPECTIVES ON ENGINEERING AND SCIENCE

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DEPARTMENTS

The beam receives its last signatures before it is placed in the structure.

Celebrating the Progress of the Integrated Engineering and Science Building

by Elizabeth Talbot, Chemical Engineering Junior

The Integrated Engineering and Science Building (IESB) is scheduled to be completed by the Fall of 2019, offering a major addition to the facilities available to Louisiana Tech's College of Engineering and Science (COES) to carry out its mission of training the high-quality engineers and scientists of the future. Most of its classrooms will be used for freshman and sophomore courses including engineering courses within the Living with the Lab program, calculus, general chemistry, statics, circuits and thermodynamics. Other offices currently in Bogard will be moved to the new building as well. The freshman engineering student help desk will have its own room in the building rather than sharing a Living with the Lab classroom. The new classrooms were designed with input from experienced faculty to ensure that each room will be an effective space for teaching and learning. Along with these classrooms, many faculty offices will relocate to the IESB, including the Undergraduate Studies Office. Although the IESB will have a majority of freshman and sophomore classrooms, upperclassmen will benefit from the new building. There will be high-quality study spaces throughout the building, ranging from tables in open areas to enclosed meeting rooms.

On October 5, 2018, the final beam of the building's structure was placed in front of Bogard Hall for students, faculty and staff to sign. Various COES clubs took shifts throughout the day to supervise the signing. The following day, a topping off ceremony was held to celebrate the progress of the Integrated Engineering and Science Building structure.

Louisiana Tech's Coordinator of Programs and Development, Ryan Richard organized the topping off ceremony, which occurred on October 6, 2018. The ceremony opened with the National Anthem played by COES majors within the Band of Pride. Many University faculty and staff attended, including Dr. Hisham Hegab, dean of the College of Engineering and Science, Dr. Les Guice, president of Louisiana Tech, and Dr. Dan Reneau, former president of Louisiana Tech. Other dignitaries, including Dr. James Henderson, the University of Louisiana System President, state legislators, Mayor Ronnie Walker, and Governor John Bel Edwards, also made appearances at the ceremony. Governor Edwards remarked on the importance of this new building, which happens to be one of the few state-funded academic buildings that he authorized since his election. He also recognized the positive impact that STEM (science, technology, engineering and mathematics) jobs have on Louisiana's economy. The ceremony ended with a senior chemical engineering student, Adam Ramachandran, singing the Tech Alma Mater.

With the setting of the final beam, the IESB's construction will continue to conclusion by this summer; it is expected that the building's construction will finish in time for operation during the Fall 2019 quarter of next year. Its completion will usher in a new era for Louisiana Tech's COES program by offering a state-of-the-art facility and equipment to aid faculty and students alike in their respective pursuits of providing and receiving a high-quality education.

The 2018 Graduate Council with Associate Dean of Graduate Studies and Graduate Council Advisor Dr. Collin Wick. Front row from left to right: Imran Hossain, Abhishek Panchal, Jolin Rodrigues. Back row from left to right: Hillary husband, Kimlin Hall (Office of Graduate Studies, COES), Dr. Collin Wick, Nwankwo Chinonso

COES Graduate Symposium 2018: Follow the Science to Tech it Higher

by Imran Hossain, Micro-Nano Systems Graduate Student

While the rest of the College of Engineering and Science (COES) busied themselves keeping up with exams and deadlines, grad students from the College showed off how research is done at Tech. On December 14, members of the 300 strong graduate student body displayed their research to Bulldog fans at the Graduate Research Symposium organized by the COES Graduate Council, an organization that represents graduate students within the College.

The COES Graduate Council disseminates information to the student body and administration/teaching staff and helps organize oral and poster presentations that showcase the effort graduate students put in for research activities for the University and the community in general. As part of their duties, the organization hosted a research symposium on December 14, 2018. The symposium featured posters and presentations on a computer simulation of the effect of aging, hydrogels for bacterial release, expansive soil models from all parts of Louisiana, a hair care formulation (patent pending) and many other projects under the same roof.

“This conference has brought together the graduate students and the faculty of COES to share results and discuss issues on related topics through oral presentations and poster sessions,” says Debojit Sarker, a doctoral student in Engineering with a concentration in Materials and Infrastructure Systems at Louisiana Tech. “This unique blend of formats provides an opportunity to learn and exchange information on the latest scientific developments in a variety of interdisciplinary areas,” he added.

Considering that the majority of graduate students come from outside of the U.S. and the amount of external funding for graduate research, the term “The World comes to Tech,” truly applies to graduate studies within the College. Graduate students within all programs in the College do a significant amount of research, carrying out their work under the guidance of their respective advisors inside buildings across campus. This symposium provides an event, not only to showcase research, but to bring these students together.

The event was a huge showcase for COES graduate students. At the Symposium, faculty judges evaluated students’ work, giving valuable feedback and incentives and recognition for the best work.

The best presenters were rewarded with a luncheon with Louisiana Tech President Dr. Les Guice. During the luncheon, attendees had a lively discussion with him about the issues facing graduate students in the COES. Dr. Guice was very passionate and discussed things students need to keep their best work going.

“We are amazed by the enthusiasm of COES graduate students,” says Abhishek Panchal the president of COES Graduate Council. “This goes to show the commitment of our graduate students towards their research and the value they keep adding to the University in general and research community in particular,” he added.

“Hopefully, this will be a platform for future events all across COES,” said Hillary Husband and Jolin Rodrigues in chorus.

Through this event, the COES Graduate Council aims to encourage collective research and draw attention of the University to the path-breaking research that occurs right here on campus.


Undergraduate, graduate, and faculty participating in the 2018 CIMM symposium at Louisiana State University

CIMM: Consortium for Innovation in Manufacturing and Materials

by Luke Hansen, Mechanical Engineering Junior

In casual conversation, the term “university” usually invokes thoughts of higher education and student advancement. However, for centuries universities have been on the frontlines of scientific discovery along with their role in education. Groundbreaking discoveries such as the atomic nucleus, nuclear power and Maxwell’s equations have all resulted from university research. The invaluable contributions of university research to academia and society do have a price, however, and universities must receive adequate funds to continue their research. In public, state-sponsored universities, a significant portion of research funds are provided in the form of National Science Foundation (NSF) grants. A grant proposal is written and selected based on the intellectual merit and broader impacts of the proposal. In August 2015, one of the largest grants in Louisiana history was proposed by the Louisiana Board of Regents on behalf of five Louisiana universities. The NSF awarded a grant of 20 million dollars to the five universities, which included Louisiana State University, Louisiana Tech University, Grambling State University, Southern University, and the University of New Orleans. The grant led to the formation of the Consortium for Innovation in Manufacturing and Materials (CIMM) to oversee the application of the grant. CIMM was founded with goals centered around research, education support and collaboration. Within each goal, several steps were laid out to measure the progress of CIMM.

CIMM covers a broad range of research topics related to advanced manufacturing methods and materials. There are two science and technology thrusts (STT) that are the primary research focuses emphasized by CIMM. The first science and technology thrust (STT1) centers around multiscale metal forming and replication-based manufacturing. In other words, STT1 research investigates the challenges of fabricating metal microstructures and how to fabricate the structures in an economic and scalable process. One example of an STT1 funded project at Louisiana Tech University is the heat transfer performance of fabricated micro-fin arrays in a pool boiling apparatus. The second science and technology thrust (STT2) focuses on material design, processing and characterization for laser-based metal 3-D printing. One current challenge in 3-D printing metals lies in the difficulty of manufacturing the metal powder used in layer-by-layer 3-D printing. In addition, the fundamental science behind the formation of the metal parts requires further explanation.

Education outreach within Louisiana is another goal of CIMM. The outreach begins with the faculty of the five CIMM universities. New early career faculty members have been hired and mentored to conduct CIMM research. Diversity is especially important within CIMM when selecting new faculty members, graduate students and undergraduate researchers within CIMM. Undergraduate students are given the opportunity to learn and experience graduate research through the Research Experience for Undergraduates (REU) program. REU positions for CIMM research take place in the summer and give students valuable experiences in research. CIMM faculty members reach out to other educational centers such as community colleges and elementary schools throughout Louisiana. Science demonstrations and technology seminars are provided to encourage youth to pursue higher education in STEM fields.

Another goal of CIMM is to encourage the collaboration of CIMM partnered universities throughout the state. Collaboration between universities allows the participating universities to share equipment and facilities. Over twenty-five graduate researchers from seven disciplines received funding from CIMM, and projects often have multi-institutional teams of researchers from different universities. For example, the heat transfer studies on micro-fin arrays in pool boiling under the STT1 are fabricated at Louisiana State University, tested at Louisiana Tech, and predicted with computational analysis at Southern University. In addition to university collaboration, industry collaboration is encouraged by CIMM to achieve the maximum benefits of university research. Start-up companies that utilize the discoveries made by CIMM strengthen the workforce and economy of the state.

As of the 2018 CIMM symposium this past July, the Consortium is currently on schedule to meet the full potential of its goals by the grant’s completion on March 2020. Several findings have already been published by teams within the STT1 and STT2 objectives, and work continues to progress in these areas. Dozens of undergraduate and graduate students have been mentored through CIMM sponsored research, and many elementary-level students witnessed scientific demonstrations within their schools. The increased collaboration of universities has led to research that utilizes all the equipment and faculty in Louisiana’s public universities. At its current progress, CIMM will be remembered in history as a scientific push that not only funded universities but changed Louisiana for the better.

Dr. Bishop working with Muhetaer Tuerhong and Cary Randazzo on the LittleFe computer

Little Debbie and Her NanoCar

by Christopher Rodriguez, Cyber Engineering Senior

Computer science is often focused on finding algorithms that complete assignments in a timely manner regardless of the size of the computation. Some problems simply require complex algorithms. Other problems must manipulate extremely large datasets. In most cases, computational time can be reduced by bigger or faster hardware (like moving from a laptop to a desktop), but for large datasets, even the fastest processor would take years to finish. So, what can be done when facing problems like protein folding, database searching, physics simulations or deep learning on millions of examples?

High-performance distributed computing can be used to solve problems in just days which might otherwise take years to run on a normal computer. This speedy computation is achieved by breaking the solution into smaller problems that are distributed to computational nodes that are combined into a single computer cluster. The typical home computer might have two or even four processors, but super computers can have thousands to tens of thousands of nodes, each containing multiple processors with multiple computing cores. All of the nodes can then be utilized to solve the overarching problem. Still, constructing and using a super computer is not as simple as just hooking up more processors to a motherboard and clicking "run." Each node in a cluster functions as an autonomous computer with its own memory, hard drive and operating system. Making sure that they all work together efficiently is not a trivial problem.

Most students never get the chance to work with computer clusters. The few lucky students that get experience with cluster computers usually only get to interact with them remotely over a secure shell (ssh) or similar protocols. While this is the normal way to interact with a cluster, the hardware, operating systems and computer administration tasks are purposefully hidden from the user to simplify the user experience and provide a secure computing environment. This lack of transparency often means that students don't get a chance to really understand what goes into making a cluster computer function well.

During the Spring Quarter of 2018, Dr. Tom Bishop, associate professor of chemistry, molecular science and nanotechnology, nanosystems engineering and physics, led a class of seven students to explore high-performance cluster computing using a Little Fe computer. ("Fe" is the chemical symbol for iron, and supercomputers are often referred to as Big Iron.) Little Fe is a computer cluster that consists of six Netbook computer nodes combined together within a single frame and connected to a network switch. Each of the nodes can be connected to a display unit, have their power toggled, have USB devices connected to them and be connected and disconnected from the network. These features make Little Fe an ideal platform for students to get a hands-on learning experience in high-performance cluster computing and all the ways such a system can fail. The skills learned are in high demand.

The students reconfigured Little Fe with a Debian variant of the Linux operating system. Little Debbie is more user friendly and has a more extensive software stack than Little Fe. They then learned how to install the Nanoscale Molecular Dynamics (NAMD) software to run molecular dynamics simulations. The students first experimented with molecular simulations of Bovine pancreatic trypsin inhibitor (BPTI), a small protein found in cattle, using different configurations of Little Debbie. After developing a strong understanding of the computer architecture and simulation methods, the team began developing a NanoCar simulator. They created a computational model of a chemical structure made primarily of carbon atoms and placed the molecule on a fixed gold surface. When they applied heat to the system to reach a temperature of 310 K, the NanoCar randomly traveled over the surface at speeds on the order of a nanometer per nanosecond or approximately 2mph.

In the future, Dr. Bishop hopes to expand this class so that more undergraduates can be exposed to molecular dynamics and high-performance computing using the NanoCar and Little Fe. Hands-on opportunities like this offer Louisiana Tech students educational opportunities that cannot be found everywhere. The class, Applications of Parallel Computing in Bio and Nano Molecular Modeling, was the result of a COES Innovations in Education Grant. Dr. Bishops seeks to grow the Little Fe into a family of Littles (Little Susie, Little Red, Little Mints, to name a few) corresponding to different Linux distributions, and he wishes to continue exploring the modeling and simulation of NanoCars and Biomolecules.

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SENIOR SPOTLIGHTS

Katherine "Kaki" Willrich

by Parker Willmon, Biomedical Engineering/ Mathematics Junior

Kaki Wilrich is no typical senior. She is a 38-year-old student with two daughters and a husband. Not only that, but she is also active in the community. She teaches an adult education program at Rolling Hills Ministries and has volunteered with everything from truancy programs to domestic abuse shelters. She even cooks as a hobby and goes to lunch weekly with a widow from her church. Despite this full schedule, she still managed to maintain a 4.0 grade-point average while studying mathematics. When asked how she manages to balance her family life, volunteer work and school, Kaki said it is a bit of a balancing act, but it comes down to her family being supportive and calculus homework being scribbled on the back of recipe cards.

Kaki plans on earning a Ph.D. in Mathematics here at Tech after she graduates. With a Ph.D. in hand, she hopes to teach at a university and do STEM education research. Originally, Kaki did poorly in math but was always interested in the field. Because of this, she hopes to teach introductory math classes and early calculus classes to show students that math is fascinating and that it is not an obstacle between the pupil and their degree.

Kaki gave two major pieces of advice for younger students. The first was "if it's not your timing to be in college, you can still come back again. Don't give up. You get more focused as you get older." Her second piece of advice is for everyone and comes from watching her daughters. "I think if we can remember to never ever give up, to always pick ourselves up and keep going, and always have enough faith to try things that we could never do by ourselves in the first place, then there's no limit to the things that we can do and accomplish."

Ryan Botts

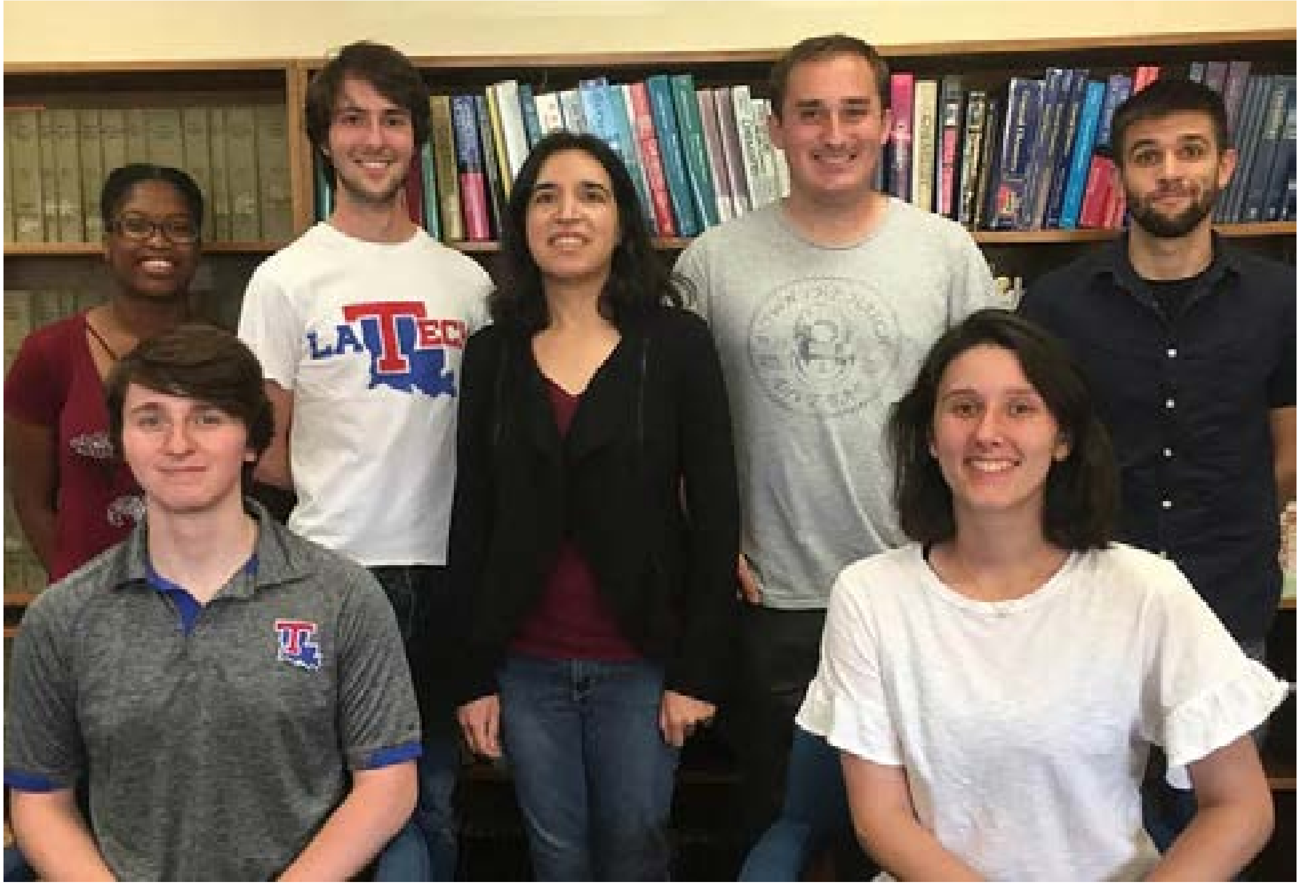
by Erik Romero, Cyber Engineering Freshman

Four years ago, Louisiana Tech welcomed Ryan Botts onto its campus. Since then, Ryan has distinguished himself through the development of new student organizations, his knack for innovation and design, and as the graphics editor with E&S Magazine. Before landing in Ruston for his studies, Ryan spent most of his life overseas. He lived in Panama, Japan, Iceland, England and Hawaii. When asked what influenced his choice of Louisiana Tech as his college, he answered that the "engineering program was recognized as a [top] performer." He also enjoyed the small town feel that Ruston offers. Initially a mechanical engineering student, Ryan switched to industrial engineering and graduated in the Fall of 2018.

Ryan was a member of the Science, Technology, Engineering, Art and Mathematics (STEAM) organization and Operations Tech where he helped students develop new skills in prototyping and problem-solving. He founded the latter two years ago during his sophomore year with the intention of improving life on Louisiana Tech's campus. While Ryan spends a large amount of time helping in a variety of organizations, he also enjoys photography, which is the main reason he enjoys traveling during summers. Most importantly though, he plans to continue studying to get a master's and a doctoral degree in industrial design.

The biggest advice Ryan has to incoming freshman is to ask themselves: "What is your mission in life; the 'why' behind everything you are doing?" If you don't know the answer, don't be afraid to explore because "you don't have to know exactly what your mission is, but you probably have an idea of what it might be. Explore that and make sure that by the time you leave Tech you've developed the understanding of your mission so that you can contribute to society to your fullest potential."

Between changing the game of innovation on campus and being an amazing graphics editor, Louisiana Tech and the E&S Magazine are grateful to have been able to share the past four years with Ryan.



From left to right: Lauralee Sylvain, Andrew Brown, Brandon Cooper, Dr. Fatila, Kelsey Schellinger, Riley Cooper, and Jackie Ashley

Dr. Elisabeth Fatila

by Elizabeth Kibodeaux, Electrical Engineering Sophomore

The E&S Magazine would like to introduce one of the fresher faces on our campus: Dr. Elisabeth Fatila, assistant professor of chemistry and molecular science and nanotechnology. Since she arrived at Louisiana Tech last year, Dr. Fatila made great strides in improving the chemistry labs and in her own lanthanide-based research. One may ask: How did a person from chilly Ontario come to work in warm, humid and charming Ruston, Louisiana?

Dr. Fatila was born and raised in St. Thomas, Ontario—a Canadian town of about 35,000 people. She stayed in Ontario for both her undergraduate and graduate degrees, acquiring both from the University of Guelph in Guelph, Ontario. She graduated from her undergraduate program in Chemistry and went on to receive her Ph.D. in Inorganic Chemistry.

Even though she published many findings from her Ph.D., Dr. Fatila felt lost on what to do with her education. After several co-ops, she realized that she preferred research, especially research involving lanthanides, over anything else. Through this passion, she discovered Professor Ken Raymond at the University of California in Berkley. She applied for a post-doctoral fellowship and much to her disbelief, she got it. Thus, her journey to the United States began.

Unfortunately, it did not take long before Professor Raymond's funding was cut, but, luckily for Dr. Fatila, she received an opportunity to work in Indiana in a research-based industrial position. She managed to publish several articles from this experience. While working there, she ultimately decided to apply for a position at Louisiana Tech. When called down for an interview, she discovered that she loved it here! When asked why, she said, "The biggest reason [was] the students. They are so respectful and kind and easy to work with."

Upon her arrival, Dr. Fatila sought to improve lab conditions, not only for her own research, but for the students as well. She enjoys working closely with students through her co-chair position in ACS and the many classes she teaches, including: General Chemistry, Inorganic and Advanced Inorganic Chemistry, and Introduction to Research. Her current research involves lanthanide coordination complexes and methodologies for making them. Dr. Fatila's efforts thus far show that her career at Louisiana Tech will be nothing short of remarkable, and her passion shown already demonstrates how fortunate COES students are to have such a talented professor of chemistry.

Philo T. Farnsworth: The inventor of the first fully electric television

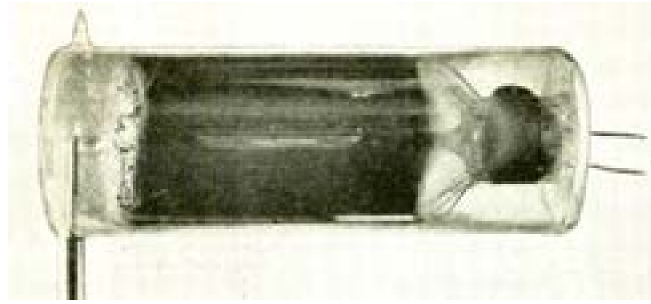
Philo T. Farnsworth

by Katie McKenzie, Biomedical Engineering Sophomore

Most people cannot claim that they thought up a world changing device by fifteen, yet Philo T. Farnsworth did precisely that when he conceived the first all-electric television.

When sitting down to watch Saturday morning cartoons or the news, many do not recall that today's stunning picture quality of televisions was not always the standard. Before the 1920s, televisions consisted of hole-punched disks that when spun around, provided a small, shaky image scanned onto a screen. Farnsworth found it pertinent to innovate this system, ultimately conceiving the idea of what became the first fully electronic television. This idea has since become an integral portion of modern TV design.

Born in 1906, the illustrious inventor experienced a humble upbringing, spending his early years in a Utah log cabin. From childhood, he became enamored with science, often reading Popular Science. Molecular theory and motors were among his dearest interests. At that time in history, Thomas Edison's gramophone, which had been invented 30 years prior, held the technological spotlight. While building his wealth of electronic knowledge, Farnsworth realized the inefficiency of the mechanical system being used for what was then called television. As a matter of fact, while in high school, Farnsworth drew up a plan for a system containing a vacuum cylinder that shot a beam of electrons in lines onto a light-sensitive screen. This allowed for the electronic projection of images. On top of envisioning a world-changing invention in high school, Farnsworth also entered Brigham Young University as a special student before his high school days even concluded. Unfortunately, Farnsworth only stayed at the university for a year before his father passed away, forcing him to work to support his family while he finished high school. Despite this obstacle, the young scholar brought his idea to fruition.



The cathode ray tube: "The image dissector" that was used to channel electrons onto a screen to produce an image.

Many of the world's greatest inventions had more than one actor behind it, a fact that also applied to Farnsworth's television concept. In 1926, two years after his father's passing, Farnsworth went to work for George Everson and Leslie Gorrell, both fundraisers for charity. He convinced Everson and Gorrell to enter into a partnership with him to produce his television system. The next year, in 1927, Farnsworth demonstrated the first all-electronic television while working in his lab in San Francisco. He then managed to demonstrate it for the press in 1928. This massive accomplishment allowed Farnsworth and his partners to secure more funding and establish themselves in the technological rat race.

Farnsworth received a patent for his electric television in 1930, but the backers that owned his lab wanted to be bought out. Therefore, later that year, the Radio Corporation of America (RCA) sent the head of their own television project, Vladimir Zworykin, to inspect Farnsworth's lab. Farnsworth's invention competed against RCA's work, prompting Zworykin to offer $100,000 for Farnsworth's work, which the latter rejected. This eventually led to a ten-year battle over patents, leading to RCA paying Farnsworth one million dollars.

By the end of his life, Farnsworth, known by that time as one of the "fathers of television," became fascinated with nuclear fusion. He also received patents in that field for tubes that produced a 30-second fusion before passing away in 1971 due to pneumonia. The scientific community and users of technology lost something dear within the mind of Philo T. Farnsworth. Farnsworth's life proved impactful and purposeful, offering inspirational insight into the early development of modern TV. Farnsworth was a model scientist whose work undoubtedly will continue to influence technological advancements. One may hope that upon learning of Farnsworth's invention, a greater appreciation can be gained for something considered technologically essential.

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Satya Nadella: Bringing Microsoft into the Modern Age

by Paige Hobson, Industrial Engineering Junior

Satya Nadella, the current CEO of Microsoft, is changing the priorities of the company. Under his leadership, Microsoft left behind its days as solely a software giant. He made mobile and cloud usage the future of Microsoft and worked to make their technology more available across all platforms.

Satya Nadella began his journey to CEO in his home country of India, where he graduated from Mangalore University with an electrical engineering degree in 1988. Upon moving to the United States, Nadella continued his education by obtaining a master's degree in computer science from the University of Wisconsin.

From there he went to work with Sun Microsystems Inc., but within two years he received an offer to work with Microsoft. Nadella's initial position had him working on the development of Windows NT, which became a landmark operating system and the first purely 32-bit operating system that Windows had ever launched. Proving unwilling to get comfortable with his success, Nadella returned to school in 1997 to work on his master's degree in business administration at the University of Chicago while still working full-time at Microsoft.

Nadella worked his way up the ranks in Microsoft, and, by 1999, he became vice president of Microsoft bCentral. Just two years later, he gained a promotion to Corporate Vice President of Microsoft Business Solutions. After several more moves up the corporate ladder, including some time spent as executive vice president in charge of Microsoft's cloud computing platform, Nadella attained the mantle of CEO of Microsoft in 2014. He is only the third person to hold this position following Bill Gates and Steve Ballmer.

Upon gaining this position, Nadella quickly made clear the direction he intended to move Microsoft. During his first public announcement as CEO, he claimed that mobile and cloud will be the future, and they were to be the top priorities within Microsoft. Since his laying out of this vision, Microsoft became a major player in cloud computing services. This includes the release of Windows Phone, a mobile operating system for smart phones, and Microsoft Azure, a cloud platform targeted toward business professionals.

In addition to changing the focus of Microsoft, Nadella also changed how Microsoft deals with competitors by embracing partnerships and various collaborations with competing companies. He also encourages a healthier company culture within Microsoft. Nadella currently works to change the way people look at Microsoft, and his efforts seem to be paying off. Microsoft stock prices have soared under Nadella's leadership, tripling within the four years that he has been CEO. Satya Nadella shows no fear of moving away from tradition and adapting to the future, and he reflects that boldness upon Microsoft's journey as a company.

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The Channel Tunnel, which connects Britain to France, is a feat of engineering that the ASCE has called one of the Seven Wonders of the Modern World.

Engineering Marvels: The English Channel Tunnel

by Dillon Benoit, Civil Engineering Senior

The Channel Tunnel, or Chunnel, is a fascinating example of how major engineering infrastructural projects can simultaneously draw nations together and provide an important avenue for long-term economic growth. For much of its history, Britain remained physically isolated from the European continent by the English Channel. This separation served to protect Britain from invasion, but it also hindered trade and tourism with Europe. Following World War II, however, the relatively peaceful era experienced among western European nations culminated in a desire and need for the British Isles to draw closer to continental Europe's economic and political bloc. The completion of the Channel Tunnel signaled the realization of Britain's step toward closer ties with its closest neighbor, France, and further integration into the European region.

The first proposal for an undersea passage linking Britain and France originated from French engineer Albert Mathieu Favier in 1802. Favier envisioned twin tunnels ventilated by chimneys rising above the water surface. These tunnels would have been large enough to allow passage of horse-drawn carriages. The plan appealed to the French emperor Napoleon Bonaparte, but the British government understandably feared invasion by France, their traditional enemy, and rejected the plan. This failed project marked the first of many attempts to develop an underwater tunnel to cross the English Channel.

Actual tunneling began in the 1880s from both the British and French coasts, but after about 2,000 yards of digging, the old British fear of future invasion arose once more, leading to the sudden cancellation of the project. Public perception of the Channel's role as protector still held, and it proved slow and difficult to change. Resistance also arose from ferry and port businesses, who feared loss of revenue and jobs due to competition from a tunnel linking Britain and France. Despite these setbacks, soundings, borings and studies continued to examine the feasibility of a tunnel beneath the Channel.

By 1955, however, Harold Macmillan, the British Minister of Defense, revealed a shift in official British opinion. When questioned on what remained of Britain's strategic objections to a tunnel under the Channel, Macmillan responded with a simple "Scarcely at all," marking at last the end of the British government's justification of national security to deny construction under the Channel. Along with official approval, businesses and the construction industry viewed the idea of a fixed link as a boon, since it could create jobs and allow for the growth of businesses and trade surrounding construction of the tunnel.

The French welcomed the prospect of a link with Britain. The French expected that the Tunnel would work nicely with their successful rapid train system, the Train a Grande Vitesse. In addition, the Tunnel would promote development in the Nord Pas-de-Calais region, which suffered heavy unemployment due to declining coal, steel and textile industries. Finally, by 1984, British Prime Minister Margaret Thatcher and French president Francois Mitterand agreed on the mutual benefit of a link across the English Channel. Soon after, their respective governments released an invitation for bids on construction of the tunnel. According to USAF Lieutenant Colonel Leslie Allen Veditz's case study on the Channel Tunnel, the invitations laid out four essential rules: "proposals had to be technically feasible, financially viable, Anglo-French, and accompanied by an Environmental Impact Assessment." Following a few months of the evaluation of ten proposals, the Channel Tunnel Group/France-Manche, soon to be known as Eurotunnel, won the bid.

Digging of the Chunnel began simultaneously from both the British and French coasts in 1987, and on December 1, 1990, the two sides of the service tunnel met, amid much celebration. In commemoration, one British worker, Graham Fagg, and one French worker, Philippe Cozette, were chosen randomly to be the first to shake hands through the opening. The Chunnel consists of three tunnels: the service tunnel and the larger north and south running tunnels on either side of it. Construction of the northern running tunnel finished on May 22, 1991, followed a month later by the completion of the southern running tunnel on June 28, 1991.

Upon completion of the main tunnels, much work remained: crossover tunnels, land tunnels from the coast to the terminals, piston relief ducts, electrical systems, fireproof doors, the ventilation system and train tracks all had to be added. Large train terminals also needed to be constructed at Folkestone in Great Britain and Coquelles in France. Once construction finished, the first test run of the entire Chunnel occurred on December 10, 1993. Months later, after further fine tuning, British Queen Elizabeth II and French president Mitterand officially inaugurated the Channel Tunnel on May 6, 1994. After six years of construction and about $21 billion spent, the Channel Tunnel project concluded.

The Chunnel spans 31.4 miles in length from terminal to terminal, while 23.5 miles of the Chunnel lies at an average of 150 ft. below the seabed, making it the world's longest underwater tunnel. Eurotunnel privately financed the entire project through equity and loan capital. Despite some financial struggles by the company, completion of the Chunnel vindicated Thatcher's faith in the power of the private sector to successfully complete a major infrastructure project. Originally conceived to cost around $3.6 billion, the project ultimately cost $21 billion to complete. As with any great engineering endeavor, the manpower and assets needed to complete the project proved equally astonishing, with the workforce totaling 13,000 by the project's conclusion. To dig the tunnels, the British and French teams used a total of 11 massive tunnel boring machines, each being 750 ft. long and weighing 15,000 tons. The boring machines typically cut through the chalky soil at a rate of 360 feet per day. To waterproof and protect the tunnels' lengths from the intense pressure of the sea above, they had to be lined with 5 ft. thick concrete walls containing enough concrete for more than 100 buildings. The north and south running tunnels are 25 ft. in diameter, serving as railway tunnels, and the service tunnel has a 16 ft. diameter. Massive 14 ft. wide, 2,500 ft. long double-decker shuttle trains hurtle through the north and south running tunnels at 100 mph. Passengers board the trains by vehicle, rather than by foot. The service tunnel is accessible by emergency and maintenance vehicles. In addition to the tunnels, a sophisticated support system had to be built to maintain them:

- two 160 MW substations on either side of the tunnel,
- 25 kV catenary systems to power the shuttle trains,
- control and communications,
- air handling units located every 1,230 ft.,
- drainage systems to remove water from the tunnels,
- a fire-fighting system,
- refrigerated water cooling system, and
- technical rooms containing maintenance equipment on each side of the service tunnel.

The American Society for Civil Engineers (ASCE) described the Chunnel as "a living, intelligent structure. Huge pistons open and close ducts, relieving the pressure that builds ahead of the train's noses. Some 300 miles of [cold-water] piping run alongside the rail tracks to drain off the heat raised by air friction."

Upon the tunnel's opening in 1994, ASCE named the Channel Tunnel as one of the Seven Wonders of the Modern World. The Chunnel indeed proved itself as a major boon for Britain, accounting for the creation of 220,000 jobs, $120 billion of total trade value between the Britain and Europe in 2014 alone, and the crossing of at least 21 million passengers each year. Even now, despite the uncertainty posed by Britain's Brexit decision to leave the European Union, economic and trade ties will remain strong, and the Chunnel will continue to play a key role in those strong ties.

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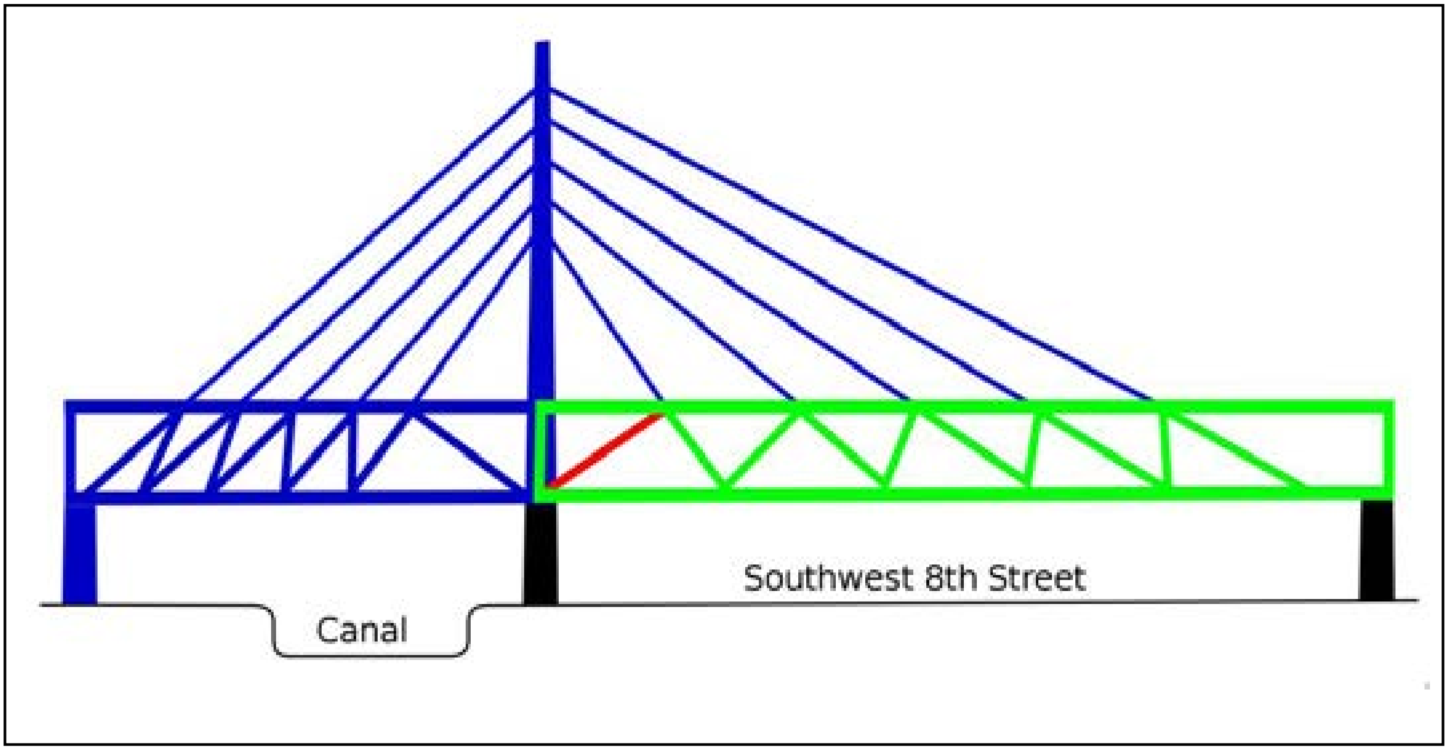

Diagram of the FIU pedestrian bridge with the critical member highlighted in red

Engineering Oops: Florida International University Pedestrian Bridge Collapse

by Austin Crawford, Mechanical Engineering Junior

“Building bridges” is a common metaphor used to describe the action of connecting people, things, places and ideas that are separated by some barrier. The bridges that we build in the literal sense often invoke ambition and aspirations for our communities, states or nations to become more than just an isolated entity, but rather an integral part of the economies and cultures of the surrounding world. As such, bridges are often designed not only with functionality in mind but also with a sense of grandeur and style that reflect these aspirations. This became the case with Florida International University (FIU) located in Miami, Florida, and their desire to build a pedestrian bridge over Southwest 8th Street into the adjacent community of Sweetwater.

The bridge would allow students to cross the road onto campus more safely, especially considering the tragic death of a student hit by a passing vehicle the prior year. It would also promote more travel between campus and the community, offering students a convenient area to socialize outside of classes while increasing FIU’s influence in the community. Being the physical manifestation of FIU’s culture, the bridge required an innovative and aesthetically pleasing design. FIGG Bridge Engineers offered a design that fit those criteria, so they won the $14.2 million bridge contract. Unfortunately, due to key design errors, the bridge collapsed while under construction on March 15, 2018. The incident killed six people, including construction personnel and motorists caught driving underneath the bridge at the time. It is a sobering tragedy for anyone in the engineering field, and it shows that even in modern times with advanced techniques and designs, the fundamentals must always be accounted for when working on important projects.

Overview of Project

The bridge in question consisted of two spans: one over the highway and one over a parallel canal. Both spans met in the middle above a main support column. FIGG employed the accelerated bridge construction (ABC) method to build and place the 175-foot main span traversing the highway. The ABC method involved the onsite prefabrication of segments to be installed onto existing support columns. The ABC method proved desirable for this project due to its cost-effectiveness and the dramatic decrease in time required to construct the bridge. The latter reason became necessary given the desire to avoid the blockage of the busy eight-lane highway for too long. Although ABC provided reliability in other instances, the design of the bridge had to take portability into account which may have caused engineers to overlook key structural features.

The university originally called for an iconic-looking cable-stay design where the main deck is supported by tension cables connected to a main support tower, not unlike the Golden Gate Bridge. However, cable-stay bridges must be constructed on-site and would have resulted in long-term road closures. Attempting to reconcile the convenience of the ABC method with the aesthetic of a cable-stay bridge, the engineering firm proposed an unorthodox truss-style bridge in which there would be a single row of concrete members in the center of the bridge connecting the walking-platform and a canopy on top. To incorporate the cable-stay aesthetic, metal pipes would connect the top of the canopy to the main support column, but they would do little in terms of load bearing.

Design Flaws

Trusses are common structural elements in bridges. They are very effective at distributing loads evenly throughout the structure and preventing any one member from bearing too much stress. However, multiple factors rendered the proposed truss design as unorthodox. First, the truss consisted primarily of concrete, instead of the more commonly used steel for trusses. Concrete is relatively weak in tension, meaning the members had to be made very thick to compensate for the weakness. This approach in turn dramatically increased the weight of the bridge. Second, the truss employed a single row of members down the center as opposed to two rows of members on either side of the bridge. This decision effectively doubled the load on each member of the truss, further increasing the need for thicker, heavier members. Finally, while at first seeming like a minute detail, the angles of the truss members had to be adjusted to line up with "cables" to make the bridge seem more appealing visually, due to the asymmetry of the bridge and the faux cable-stay design. Adjusting the angles of members within a truss changes the load distribution throughout the structure. Because of that, the bridge's load distribution efficiency diminished. These combined factors likely compromised the structural integrity of the bridge.

Several independent structural engineers performed their own analyses of the bridge design and reached the same conclusion on the design. They determined the bridge's design to be unsound, particularly at the member connecting the support column on the main span opposite from the main support column in between the two spans to the upper canopy. They deemed this member to be critical since failure in that member would cause the support column to fail, and, subsequently, cause the entire bridge to collapse. Based off the engineers' calculations, it appears the bridge design firm made the member too thin to support the required load. The likely reason for this error fell to a miscalculation in the original design plans, since the truss contained thicker members elsewhere, but they bore less of a load than the critical member in question.

Catastrophe

Even before the collapse, reports came in that cracks formed within the truss structure near the critical member, but the head engineer of FIGG brushed these reports off, claiming that they held no major concern. Repairs would be made to the cracks later. The day of the collapse, workers for MCM Construction, the company contracted with constructing the pedestrian bridge, began tightening internal support rods within the bridge, possibly as a method to prevent the cracking from spreading further. It is highly speculated that this tensioning increased the load within the critical member of the truss past its breaking point, causing the joint at the member and the vertical support column to fail "explosively," in turn collapsing the entire main span of the bridge onto the highway below.

Aftermath

The National Transportation Safety Board (NTSB) commenced a thorough investigation into the cause of the collapse. The only details about the cause of the collapse at the current moment came from speculation from outside engineers not associated with NTSB or FIU. However, the consensus from these structural experts points to a design issue that led to the fatal catastrophe. While ingenuity, convenience and aesthetics are important aspects of any engineering project, functionality and safety should never be compromised as a result. While there may have been unpredictable circumstances that led to the bridge collapse, a simple increase of the critical member's width from two feet to three feet may have prevented the failure and increased the reliability of the structure. One of the important responsibilities of engineers is to account for unforeseen scenarios and to create designs that are functional while also displaying ingenuity and creativity. In doing so, they ensure the safety of their workers, and more importantly, the public.

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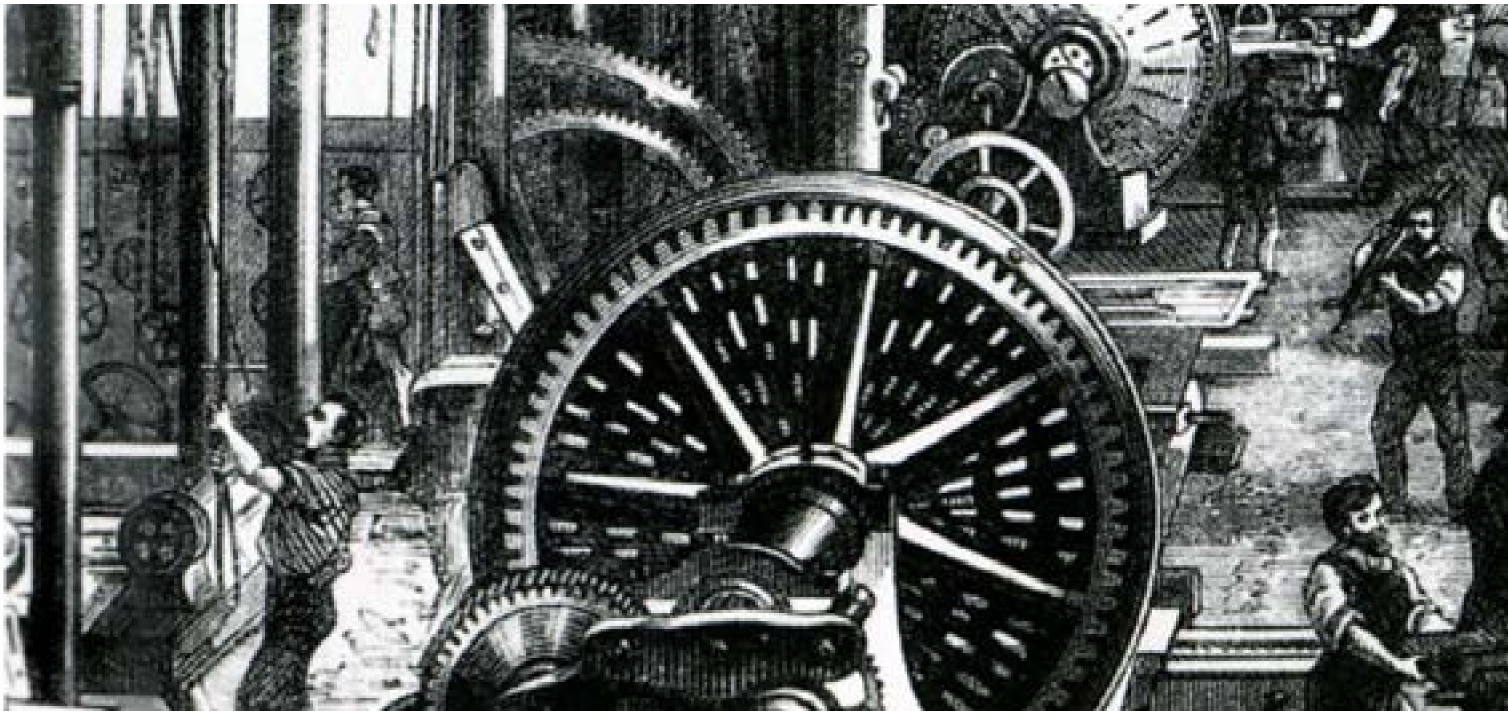


The "Why" Behind Innovation

by Ryan Botts, Industrial Engineering Senior

It doesn't take a Louisiana Tech University student very long to hear the word "innovation," whether it's in class, in conversation, or from one of the many groups using it in their name or tagline. Better yet, innovation also seems to be the buzzword in nearly every industry. The word is used to describe everything from newly designed wildfire equipment to faster muscle-building workout routines. Most people would agree that the basic idea of innovation revolves around improving daily life in some way, and that we often equate it with some level of upgrade or progress. However, there also seems to be controversy on what counts as innovation these days. This difference of opinion can be seen in how different people feel about Apple's decision to remove the headphone jack from the iPhone.

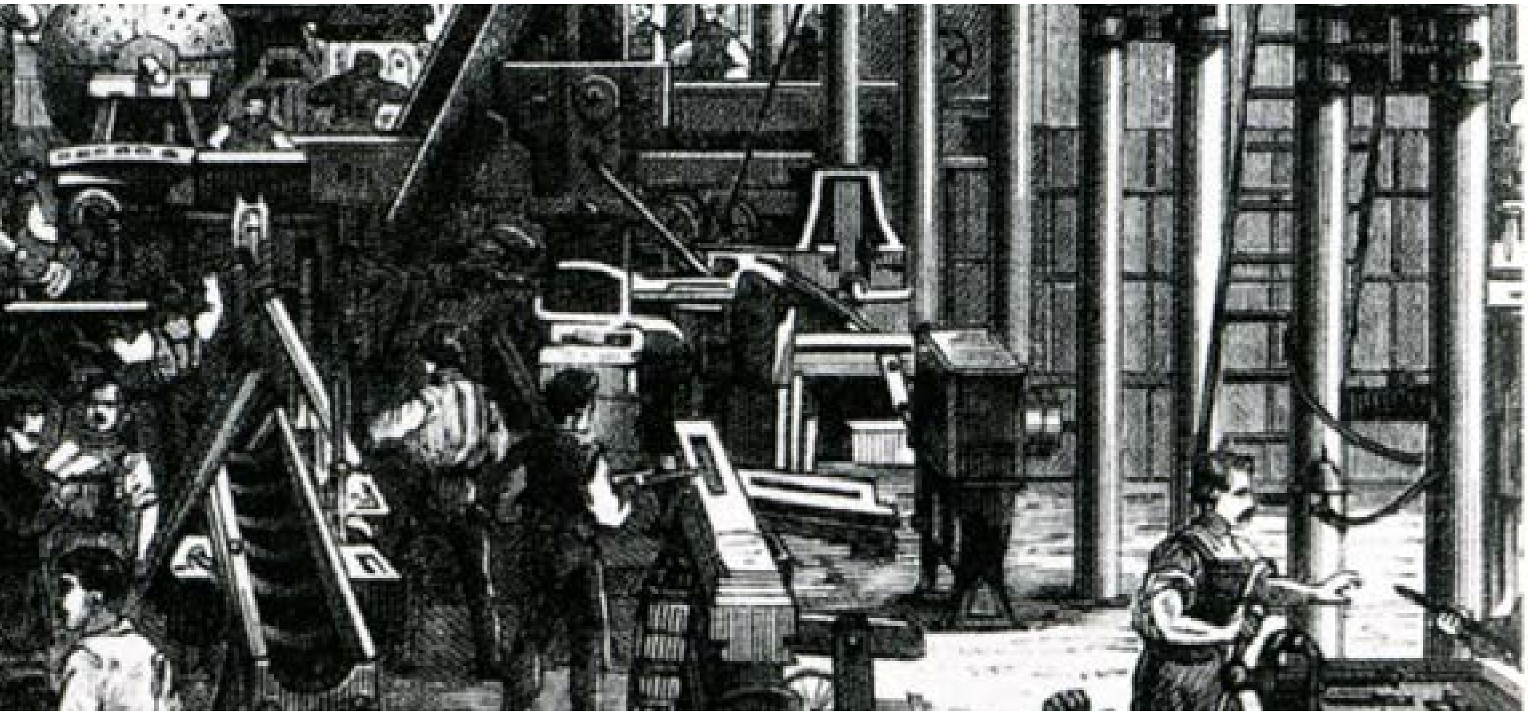
As a freshman, I heard the word innovation everywhere, from professors describing the Engineering 120 Freshman Design Series to Innovation Enterprise hosting an entrepreneurship event. Seeing and hearing that word brought out a lot of questions. What exactly does innovation mean? What value does it produce for society? Why should I care about innovation as a student? What are some ways that I can get involved with innovation on campus? Over the course of my college career, I have had many opportunities to interact with innovation at Louisiana Tech, and I've gained experience as an innovator myself. Yet, before writing this article I couldn't define innovation in a way that would fully encapsulate the term.

Dr. Heath Tims, associate dean of undergraduate studies for the College of Engineering and Science provided this overview, "Innovation from a broad perspective is such a critical part of making Louisiana Tech successful. Innovation plays an important role in everything from recruiting students to how the University as a whole is perceived among peer institutions." To understand why the concept is so important for Louisiana Tech, we first need to define it. There is a challenge with giving an exact definition for innovation, because its meaning has evolved over time and today the term is used in a wide variety of fields. So, let's explore the history of innovation and discover why it's critical that Louisiana Tech is an innovative community.

The pre-19th century concept of innovation was a renewal or alteration of ideas that had been accepted by society. Innovation was a contested practice connected primarily with the idea of change. Innovators were seen as challengers to the status quo and innovation was viewed as a negative label. Furthermore, the idea was not within the technologically centered business world like it is today, but rather it existed mostly within the fields of literature, religion and law.

In the 1800s and early 1900s, the idea of innovation shifted in application to the world of technology and business. The term became associated with economic progress, a change which altered its connotations from that of a troublemaker to an improver of daily life. With the industrial revolution bringing about a plethora of inventions and discoveries that rapidly improved the standard of living for large populations, innovation became a title given to the solutions that had clear economic or societal impacts.

In 1939, Austrian economist Joseph Schumpeter was credited with identifying one of the most well-known



definitions. According to Schumpeter , innovation is the process of taking an invention and integrating it into society or commercializing it into the economy. At this time, innovation moved from being associated with change alone to being associated with a combination of change and creativity. The output of groundbreaking inventions and discoveries during the period spanning from the First Industrial Revolution to the 1970s created an effect in which nearly every idea had strong economic or societal applications, causing the terms innovation and invention to become nearly synonymous.

This understanding of innovation is clearly present at Louisiana Tech, most visibly through our research and curriculum efforts. Dr. Richard Kordal, director of the Office of Intellectual Property and Commercialization at Louisiana Tech defines innovations as “the process of translating an idea or invention into a marketable product or service,” which closely resembles Schumpeter’s definition for innovation. A prime example of taking invention to market can be found at the Trenchless Technology Center (TTC) as described by Dr. Tom Iseley, associate director of TTC International Operations. “TTC was formed at Louisiana Tech almost 30 years ago under the leadership of Dr. Guice and myself to advance the science and practice of trenchless technology through research, education and technology transfer. This is accomplished through our commitment to innovation, education and validation of technology.”

For 30 years, TTC has utilized Tech’s research capabilities to develop marketable solutions for addressing issues with underground infrastructure. Innovation at Louisiana Tech can also be seen through programs like the Top Dog New Venture Championship and courses such as Entrepreneurship (ENTR) 430: Innovative Product Design. Both Top Dog and ENTR 430 challenge students to innovate by having them invent solutions for real-world problems and then identify pathways for bringing those solutions to market. There is, however, another version of innovation that is at play both on campus and globally.

“Innovation is the ‘let’s try it’ mindset at Tech,” said Kyle Prather, director of The Thingery, “that influences how we might engage with a number of resources, people and programs.” The Thingery is a makerspace in University Hall that provides students resources and opportunities to develop their skills in turning ideas into tangible realities. We see here that innovation is also strongly identified with the mindset of improving or creating new solutions. The distinction between this alternate definition and the previously discussed idea of innovation is that treating the term as a mindset changes the way innovation is viewed. Now, instead of the term meaning the application of an invention to the market, it is a pattern of behavior that brings new ideas to light. A popular book on the subject by Scott D. Anthony, titled The Little Black Book on Innovation, defines innovation simply as “something different that has impact.”

While this can include Schumpeter’s definition of bringing to market a new invention, it can also incorporate work with social or cultural impact and the mindset of being innovative. Further clarifying his view on innovation, Anthony continues, “innovation is a process that combines discovering an opportunity, blueprinting an idea to seize that opportunity, and implementing that idea to achieve results. Remember — no impact, no innovation.” Challenging students to practice innovation as a form of instruction is innovative when compared to traditionally teaching students through lectures and examples. Innovation, by any of its definitions, requires time, effort and (usually) money; bringing us to another question, why innovate?

The question of why we should innovate also has a variety of answers. Dr. Kordal stated that “it is generally accepted that to remain competitive in the global economy, one must continue to innovate. This enables companies to develop cutting-edge products that can command premium prices. Among the benefits is that industries can pay higher wages, increasing society’s wealth.”

Innovation provides a means for raising standards of living, staying competitive with other regions and improving the quality of life by strengthening the economy. Louisiana Tech’s Chief Research and Innovation Officer, Dr. Dave Norris, stated that “innovation at Louisiana Tech engages a diverse group of students, faculty, and external stakeholders in a way that enhances the students’ unparalleled educational experience and seeks to generate meaningful impacts on economic activity and the grand challenges of the 21st century in health, energy, cyber and more. We believe this is part of the University’s core mission in education, research and economic development. Innovation is how we operate.” He points out that in addition to the economic impact that innovation provides, there are social and cultural impact.

Dr. Tims further explained that “innovation at Tech includes everything from curriculum innovation to research. Louisiana Tech has a long history of coming up with new programs and new curricula, and also developing new ideas.” From an institutional level, Louisiana Tech works to provide an unparalleled educational experience for students, developing new courses to address evolving industry demands and instilling in students the skill sets needed to be successful. Dr. Norris also mentions the need to address the challenges the world faces today. Louisiana Tech is innovative so that it can create graduates capable of working on the front lines of our most pressing issues. In addition to the curriculum developing a student’s knowledge and critical thinking capabilities, the growing ecosystem of ambitious student organizations enhances Louisiana Tech’s commitment to innovation. A few examples of student-led organizations include:

Eco-Car, which develops extremely fuel-efficient competition cars each year for the Shell Eco-marathon,
the Aerospace Engineering Club, which designs, builds and launches drone, rocket and high-altitude balloon projects,
Operations Tech, which develops students’ creative confidence through social innovation and rapid prototyping,
and the Innovation Alliance, a coordinating body made up of representatives from the colleges and organizations directly involved in innovation, entrepreneurship and design.

Furthermore, the Innovation Alliance also works with University administration to promote and support Louisiana Tech students who are fellows of the University Innovation Fellows (UIF) program, a program of Stanford University’s Hasso Plattner Institute of Design that works to develop student leaders who create new opportunities by helping their peers develop an entrepreneurial mindset, define problems and address global challenges.

Director of the TTC, Dr. John Matthews said, “Innovation is a key impact that universities such as Tech must have as it is important for the success and growth of our region. Under the leadership of Dr. Guice and Dr. Norris, Tech is focused on developing innovations that will help our University and area grow and become even more prosperous.”

The reason we innovate as a community is to increase our economic impact, our cultural presence, and our ability to improve society.
Dr. Kelly Crittenden, associate professor of mechanical engineering, summarized with “we invest into innovation as a means of bettering the people connected to Louisiana Tech University. [...] Innovation drives the world forward in a mutually beneficial direction.”

At Louisiana Tech, innovation is used as both a tool and a mindset. It is the process through which the incredible research and technology that takes place at Louisiana Tech reaches the rest of the world. It’s how we share our knowledge so that others may benefit. We look at the characteristics of the industries we are in and take advantage of opportunities to create valuable impacts there. Dr. Norris put it right when he said “innovation is how we operate”. Our ability to innovate grows when we get more students involved in research projects and student organizations. We continue to improve our course offerings and take advantage of new opportunities to produce value for both the University and the region. We benefit from the support of not only industry partners, but also our incredible network of alumni who give back to Louisiana Tech, further increasing the value of its educational offerings and reputation. Visit these sites to learn more about innovative research (http://research.latech.edu), news about Louisiana Tech’s innovative spirit (https://www.latech.edu/news/), and work being done to get more students involved with innovation (http://latechinnovation.org/).

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Dr. Melanie Watson and her daughter, Claire Juliette Watson-Ray

Melanie Watson, Ph.D.: How a Mother's Love Inspires an Innovative Medical Solution

by Megan Ward, Biochemistry Sophomore

How far would you drive for blood tests? Five minutes? Fifteen minutes? How about four hours?

During her second trimester, Melanie Watson, Ph.D., found out that her daughter had Trisomy 18, also known as Edward's syndrome. Three copies of the eighteenth chromosome cause this genetic condition and many health complications, including heart problems. Most babies with Trisomy 18 do not live to see their first birthdays. However, Claire Juliette Watson-Ray inherited her mother's fighting spirit. Claire just saw her sixth set of birthday candles.

Unrelated to her genetic condition, Claire was diagnosed with hepatoblastoma, a type of liver cancer, at the age of 14 months. At the time, her mother, Dr. Melanie Watson, worked as an assistant professor of biomedical engineering at LeTourneau University in Longview, Texas. Once a week, Dr. Watson drove four hours from Longview to Houston for Claire's chemotherapy treatments and sometimes just for blood tests.

Standing in a crowded elevator with people cooing over her immunosuppressed baby, Dr. Watson thought there had to be something she could do. "I'm a biomedical engineer. I can do this," Watson said. There had to be a better way for chronic patients to get their blood tested.

Individuals with diabetes can use various glucose monitoring devices to determine their blood glucose levels in real time. Engineers have created devices that work with smartphones to test these glucose levels. However, the devices are not typically available to patients; they are available only to physicians. Additionally, these devices are costly. What stops engineers from creating a similar device to help chronically ill patients test their blood?

Nothing. Dr. Watson, a three-time graduate from Louisiana Tech University, works tirelessly to bring such a product to the market. Dr. Watson's desire to provide the best care possible for her daughter led her to create a device that works with smartphones to provide blood test results in real time.

Currently, she works as an associate professor of biomedical engineering at Trine University, in Angola, Indiana. Both the university and her students invest their resources into the product. Trine provides funding for Dr. Watson's project, and some of her students contribute their time, aiding in the research and development.

The device uses one drop of blood to provide results for simplified complete blood count, blood urea nitrogen (BUN)/ creatinine and potassium levels. A drop of blood is placed on a cartridge that slides into a smartphone case, and the cartridge then takes an image of the drop of blood. The cartridge works in tandem with an application on the smartphone. This application then uses an algorithm to process the images and provide blood test results within minutes.

This device is not meant to replace the need for a physician. Rather, Dr. Watson seeks to have these results sent to the patient's designated physician. Simply, she designed the device to "enhance the patient/ physician relationship." She hopes this device reduces the amount of in-person blood testing from every few days to every two weeks. This less frequent in-person blood testing decreases the patient's exposure to other illnesses and decreases costs.

Depending on partnership agreements, Dr. Watson's device could be out in less than three years, and she seeks to make her product available to everyone.

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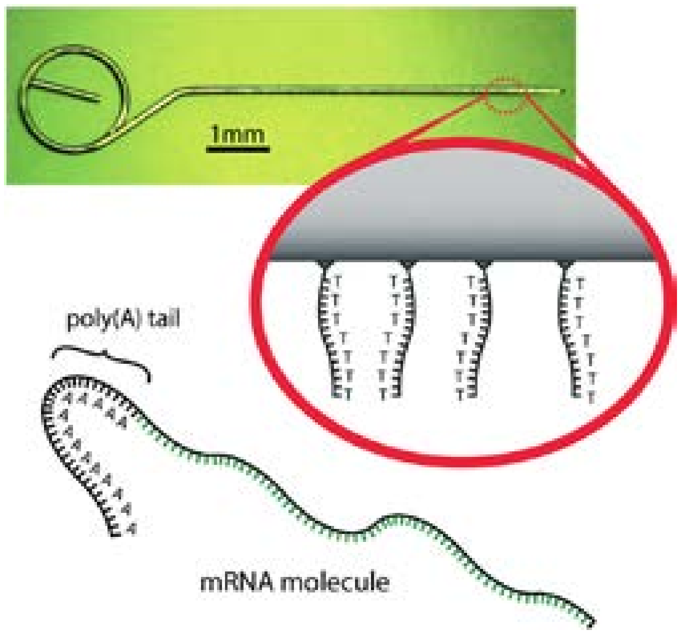

Diagram of a functionalized needle and a mRNA molecule

mRNA Extraction Using Functionalized Needles

by Thomas Holland, Biomedical Engineering Junior

DNA sequencing and testing has a special interest in the scientific world. Through DNA testing we can create specialized medical treatments, understand mutation, track genetics, target specific viruses and tumors, and access a host of other possibilities. One of the key aspects of any DNA testing is the process of PCR or polymerase chain reaction, which is the replication and amplification of a specific segment of DNA. While PCR is a simple process, scientists must go through the lengthy process of extracting tissues and then isolating the target DNA. However, through the use of specialized needles, this process can be shortened to a simple pinprick.

PCR begins with a mixture of buffers, proteins, enzymes and primers. The buffer protects the cells from damage; the enzymes and proteins facilitate the replication, and the primers enable the replication of a specific segment of the target DNA. A small amount of DNA is added to the mixture, and the mixture goes through repeated cycles of heating and cooling. This cycle causes the proteins and enzymes to activate and replicate the DNA. This process is capable of turning a single strand of DNA into millions of strands. Now that the segment of DNA has been amplified, any number of tests and experiments can be performed.

The only question now is where does the DNA come from. Since all cells contain the same DNA, a sample can be taken from any part of the specimen. There are multiple techniques for extracting and purifying the DNA, but they all involve the same basic aspects. First, the cytoplasm of the cells is broken down using chemicals and enzymes. Then, the proteins and RNA are similarly broken down. Proteins that bind to the DNA are then added, these proteins typically enlarge the DNA in some way. Next, the sample is put into a centrifuge. This centrifuge separates the bonded DNA which then can be extracted from the main mixture. This process takes time and precision to ensure accuracy.

To aid in DNA extraction, Louisiana Tech faculty Dr. Gergana Nestorova and Dr. Niel Crews created a method of extracting mRNA using functionalized needles. To facilitate the extraction of mRNA, the needles have immobilized oligos attached to them. Oligos are artificially created strands of nucleotides. These strands have the same form and substance of DNA, although, they do not contain any genetic information. These oligos are made specifically to be complimentary to the tails of mRNA. This complimentary relationship allows the mRNA to bind to the oligos. Once the needles have been functionalized, they can now be inserted into sample tissues directly into the target cell. Only the mRNA will bind to the oligos. Despite other particles clinging to the needles, the irrelevant portions can simply wash off.

Now that the mRNA has been extracted, it must go through a process called reverse transcription or RT. RT converts mRNA back into DNA using enzymes and proteins. RT is the same method that the body uses to convert DNA into mRNA but in reverse. This process takes a matter of minutes. After reverse transcription, PCR can be accomplished like normal and the DNA tested.

This method of mRNA extraction is quicker than traditional methods. It is also cost efficient because the only equipment required is the needles and a few other reagents. The major downside to this process is the difficulty of handling the needles, which is currently being addressed. Once a more convenient handling method is created, these needles will increase the ease and availability of DNA testing. This technique even has great potential for applications on the international space station.

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NASA or No?

by Caleb Swafford, Mechanical Engineering Junior

Have you ever heard of NASA? Chances are, you have. In fact, most people would be surprised if you hadn't heard about NASA. Have you heard about SpaceX? Chances are still pretty high that you have. You probably know them as a popular and privately-owned aerospace manufacturer. But, five years ago, you likely would not have known that a company by that name existed. This highlights the growing involvement of the private sector in space travel and space exploration. Private aeronautics companies are now performing a larger role in space than ever before. This fact raises many questions about the role that the private sector should play in space. Should the government regulate and run space exploration, or should that effort be left to private companies?

For many years, NASA stood as the biggest entity in space exploration. Today, NASA is still seen by many as the leader in space exploration and research, but it is no longer the only major contributor to the fields. The space program of the United States, more than any other country, has a thriving private-sector component. It is a component that is well-established and rapidly growing, and many people think that in the future the private sector will outstrip even such giants as NASA. The private sector in the United States has a long history of producing products for NASA and aiding the administration with technology development; some people see it as the next step for the private sector to become the leader in space.

Economically speaking, it has been extremely lucrative for private companies such as Boeing and SpaceX to contract with NASA. Since 2010 NASA invested over $300 million in the private sector for a program to develop a new space shuttle. NASA also awarded more than $8.2 billion in contracts and in Space Act Agreements (SAA). SAAs are legal agreements that NASA enters with partners to advance NASA mission and program objectives. Yet as much as NASA and the private sector aided one another, some suggest that private companies work best on their own.

In an article entitled "Capitalism in Space" Robert Zimmerman lists the motivations of government space programs as military strength, natural resources, economic growth and national prestige. Private, independent companies, Zimmerman says, do not have these concepts as their motivations. "Instead, these private entities have been driven by profit, competition, and in some cases the ideas of the visionary individuals running the companies, resulting in some remarkable success, achieved with relatively little money and in an astonishingly short period of time."

Mark Rober, a mechanical engineer with a popular YouTube channel, and a former NASA employee, presents the other side of the argument: "[private companies are] incentivized to pursue technologies that will give them a return on investment like space tourism or asteroid mining or launching satellites for other organizations. There's just no incentive for a private company to invest in tracking and deflecting asteroids or investing in earth science missions…and then making the data available for free to anyone who needs it." Those programs he mentions, deflecting asteroids or making experimental data from research available for free, are both things that NASA does, along with a host of other projects and programs that aim at improving and protecting earth.

So what's the answer to the question? Should space exploration depend on government funding, or private funding? The answer isn't clear yet, but it likely does not fall clearly on one side or the other. Rather, it is likely somewhere in the middle, involving compromise and working together. As events unfold and we delve deeper into space, our greatest achievement will be that we are grounded in solidarity and a common desire to learn and improve our world.

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An artist's rendering of a terraformed Sahara Desert

A Green Sahara: Is Afforestation the Solution to Climate Change that Mankind Has Been Looking For?

by Darby Ryland, Civil Engineering Freshman

Mankind is rapidly approaching a critical turning point in how we interact with the world around us. The advance of modern civilization has created unprecedented environmental challenges in the form of climate change across the world. National leaders are forced to consider alternatives to fossil fuels, like wind and solar power, as a means of energy. City planners must also rethink how infrastructure can be adapted to allow for more walkable and bicycle friendly communities. Worldwide, engineers spearhead the development of innovative carbon capture technologies to reduce the immense amount of greenhouse gases we have already released into our atmosphere. These are but a few examples of the various solutions being provided to combat the effects of climate change.

Despite this surge in environmental consciousness, many experts remain doubtful that the solutions currently in place will be enough to reverse the extensive damage that we have already wrought to the Earth's natural systems. Sea levels will inevitably rise several feet by mid-century, causing billions of dollars' worth of infrastructural damage in coastal cities like Miami, Dubai and New York. The severe weather patterns of recent years will continue to worsen as the Earth's surface continues to warm. In its article "Responding to Climate Change," NASA states that "even if we stopped emitting all greenhouse gases today, global warming and climate change will continue to affect future generations. In this way, humanity is 'committed' to some level of climate change." NASA's prediction holds a rather apocalyptic ring to it, so what can be done? Many engineers and environmental scientists have already started devising larger than life geoengineering projects that could mitigate a great deal of the catastrophic environmental situation we currently find ourselves hurtling towards. One such idea is strikingly reminiscent of something one might read in a utopian science-fiction novel: a tropical Saharan rainforest.

The idea of terraforming the world's largest desert into a lush rainforest has several obvious benefits, including bolstered economies, biodiversity and productivity of the once barren land, should it be rehabilitated. However, the desired effect that has most scientists turning their heads is the vast amount of carbon that a forest the size of the Sahara could remove from the atmosphere. Plants are the world's oldest natural means of carbon capture technology, converting solar energy and carbon dioxide from the atmosphere into solid carbon and excess oxygen gas via the process of photosynthesis. Assuming every 10,000 square meters could hold one thousand trees and every 9.8 trillion square meters of the Saharan Desert could be utilized in this way, we are looking at a forest of approximately 980 billion trees. That is roughly two and a half times more trees than in the Amazon Rainforest in 2013. A forest of 980 billion trees would increase the world tree population by around 33%, an uptick that could capture between six and twelve gigatons of carbon per year for about a century.

The feasibility of such a colossal undertaking does bear questioning. A forest of this size would need around 4.9 trillion cubic meters of water per year for irrigation. Since the underground aquifers that support life in Northern Africa could not sustain pumping on this scale, the water would have to come from the ocean. This brings up another issue. Despite desalinization becoming increasingly cheaper as more investment and research goes into it, moving this much water through desalination plants and into the Sahara would still require roughly 19,600 terawatt/hours per year, which would cost $1.96 billion per year. Throw in infrastructure, installation and management costs, and the cost of the project as a whole likely jumps well into the trillions. The burden of financing cannot be dumped on the local municipalities, because the economies of Northern Africa could not support such a hefty project on their own. Although a cost of trillions of dollars is by no means a small price tag, it may be possible to finance the project through gas and oil taxes implemented in many of the countries that signed the Paris Climate Agreement in 2015. These types of taxes could generate income for this project (or others) while simultaneously disincentivizing unnecessary usage of automobiles and petroleum products.

The real problem with this plan does not necessarily lie with the trillions of dollars and many decades of global cooperation it would take to complete the project, but instead it lies with the possibly counterintuitive ecological repercussions that such a drastic alteration to the Earth's surface might have. Ironically, the sand that would be lost because of this project remains the key concern of environmental scientists. The same infertile, loose soil that keeps the Sahara a desolate wasteland is vital to the survival of marine ecosystems in the Atlantic. As wind travels across the Sahara Desert, it collects clouds of sand and dust particles that form gargantuan sandstorms that eventually make their way to the Atlantic Ocean. Once there, these large sand clouds, which contain nitrogen, phosphorus and iron, provide vital nutrients to large algae blooms, which serve as the foundation of most oceanic food webs.

Does this ecological factor disqualify the idea of terraforming the Sahara Desert? Many studies warn of the observable adverse effects that climate change has already unleashed on the natural systems that long served mankind for the past few millennia. Any legitimate strategy for getting the Earth's climate back on track may be complex and multifaceted, but perhaps not unachievable. For instance, even if large portions of the Sahara Desert could not be irrigated, many other younger deserts with better soil conditions present relatively easier land to reclaim over the next few decades. If replanted with trees, these lands could act as smaller, though still effective versions of the plan originally proposed. In addition, current human activities causing deserts to form at an alarmingly rapid rate must be further curtailed. Unfortunately, to do so requires a daunting level of policy and lifestyle changes across the world's nations.

Sooner or later, adaptation to the mess we have made for ourselves will become a necessity. Even here at Louisiana Tech, we have opportunities to take steps in preserving our world's fragile environment. For instance, the National Society of Black Engineers holds bi-weekly recycling drives where they collect all the recyclable materials that they can from around the community, load them onto trucks and bring them to the nearest recycling plant. The Greenscape Club offers another opportunity. Their activities recently included selling spring plants, planning and building raised bed gardens for local schools and assisted living communities, and preparing for the construction of a pollinator garden on South Campus.

Regardless of political views or lifestyle, we as engineers have an obligation to preserve and improve our beautiful planet, while still serving the needs of an advanced modern civilization. We must, above all else, continue to remain vigilant and produce solutions to address the changing climate in which we live. In time, through the concerted efforts of the world's engineers and scientists, we may yet devise a solution that will greatly reduce or eliminate the dire threat of extreme climate change while continuing to drive the progress of mankind's great technological achievements.

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The AI Revolution

by Connor Haskins, Biomedical Engineering Senior

Make no mistake, artificial intelligence is an active force within our society. Intelligence, the ability to acquire and apply knowledge and skills, can be seen in artificial hosts that drive our everyday life in the form of programs. Using a series of logical assessments, these programs digest information and respond to stimuli. The earliest forms of this came about from gaming programs like computerized chess and checkers. Fast forward to today, and we now augment our own intelligence readily with technology. Smart phones are the most relevant example to this idea. Reducing the time required to acquire new information, the human mind is exponentially more capable. This objective view of the technology gives insight into how near the approaching A.I. (artificial intelligence) revolution is.

It may be hard to consider that every person with a smartphone has access to artificial intelligence, but take a minute to think about how much more efficiently we operate with them at our disposal. As they stand, innovations on these instruments are geared toward integrating the software more seamlessly into our existence. With voice command and innovations such as Google Glass, it is generally accepted that a fully artificial-biological integration is inevitable. The perceived epitome of artificial intelligence, a humanoid or cyborg creature, indistinguishable from a human being, should not be used as a measure of progress. While we do currently co-exist with artificial intelligence, this picture remains several decades away. It is generally accepted to use the gaming industry as the 'standard' that artificial intelligence has to offer the world. Partly due to the reliability of user results, these programs offer little more than sensory stimulation, and, therefore, are confined to such parameters. Concepts like Pokémon GO and virtual reality, however, work to fully integrate this branch of technology into our world. In a more practical sense, companies all over the world employ business analytics and information systems to calculate things from location decision, to customer base, and even direction in innovation. These are all attempts to apply knowledge and skill more efficiently and establish the groundwork for a more fully integrated system. Through these programs, a company effectively develops a representative 'voice' for an artificially intelligent entity. Tablets with points of sale installed placed into the hands of people or at readily available kiosks essentially become fingers outstretched and interacting with the environment. To further inform this system, a company can either pay someone to formulate and input data in a meaningful way, or they can develop a program to do this automatically.

Eventually, these systems must account for the action of other entities, if they do not already do so. This problem raises the question of their consciousness, even if only within the parameters of business. At this point, we as a society have openly agreed to ever-increasing assistance from the technology. This implicit agreement, in turn, gives artificial intelligence endless amounts of information about us. Objectively speaking, this information has not been a problem thus far.

However, it is important to note that conversations often come up, from this author's firsthand experience, where one or more people express ill feelings of the invasive nature in how the technology acquires information. While this can bring into question matters of moral, ethical and privacy standards, this article is neither the place or time to start and finish that conversation. At present, we must accept that the influence that we allow artificial intelligence to have on our lives for now remains still within our control. Although there are programs which have reached a point of self-realization and self-reliability, we still consent.

This stage is more appropriate for appreciating the possibilities that artificial intelligence has to offer now and in the future. For one, this technology holds much promise for healthcare. It is well understood that people can vary greatly in their biological needs. Rarely does a singular method of treatment serve as a cure for every person with any given ailment. This is but the tip of the iceberg in terms of understanding health. With predictive technologies, it brings about opportunities in preventive care, elevating quality of care, and saving money all at the same time.

Along with this movement, the job market will see both significant losses and gains. Even during the time it requires for the technology to mature, the demand for programmers and technicians continues to sky rocket, while also stimulating the production of jobs related to research and the development of the hardware. Conversely, stark examples crop up like McDonald's actively updating all franchise locations to include an automated ordering system. This automation will reduce the need for the number of workers needed to take customer orders. It will also require the company to staff people to service and further improve the instruments put into place. Meanwhile, Uber is creating an automated chauffer service. As disastrous as Uber's initial trials have proven to be, there can be no doubt that countless people are working around the clock to assure accountability of such a service.

The computing power required to facilitate such a revolution calls for construction in the form of updated infrastructure. A quick google search will inform you that the market cap, or overall estimated value of investment into AI, is in the hundreds of billions of dollars, which makes for a good long-term investment in more than one way. Forbes and TechEmergence corroborate these figures and provide quips on AI's impact for the economy. For instance, in 2016, trucking companies took part in the platooning challenge made by the Dutch government. Platooning is an automated driving system that wirelessly controls vehicles by placing the vehicles closer together than they would otherwise be able to under human control, allowing them to travel as a cohesive unit. In adapting this transportation tool, they conserved 15% on fuel costs and cut on drive time. These increases in efficiency herald the possibilities of AI's power to provide absolute traffic solutions.

Four years ago, Google began implementing an AI suggestion system, which provided engineers and technicians with suggestions for settings to save energy consumption from data management centers. Earlier this year, a similarly updated system, given authority to make changes actively, began using 'counter-intuitive' methods, as described by related staff to save power. During a tornado watch period in the Midwest, the software controlling the system re-calibrated to the changing barometric pressure, temperature and humidity, resulting in conservation of power.

Elon Musk, CEO of Tesla and Space-X and a key innovator of the 21st century, recently made comments on the subject during a somewhat controversial podcast interview with Joe Rogan. He explained that artificial intelligence is much more powerful than most people are willing to realize. He also explained that sooner, rather than later, the public will have access to what can best be described as 'superhuman' intelligence. According to Musk, a neural net will offer instant communication between our minds and a computerized device. He noted that this will be available to anyone who wishes to participate in the new system, regardless of financial capabilities.

The AI revolution offers many opportunities to society and individuals as a whole. Being conscious of these capabilities is vital, with the need for understanding becoming exponentially more important for people all over the world. Please take a minute to consider what it might offer you, or better yet, what you might be able to offer, with the help of artificial intelligence. Find a way to contribute to the inevitable, as the idea of futuristic becomes obsolete.

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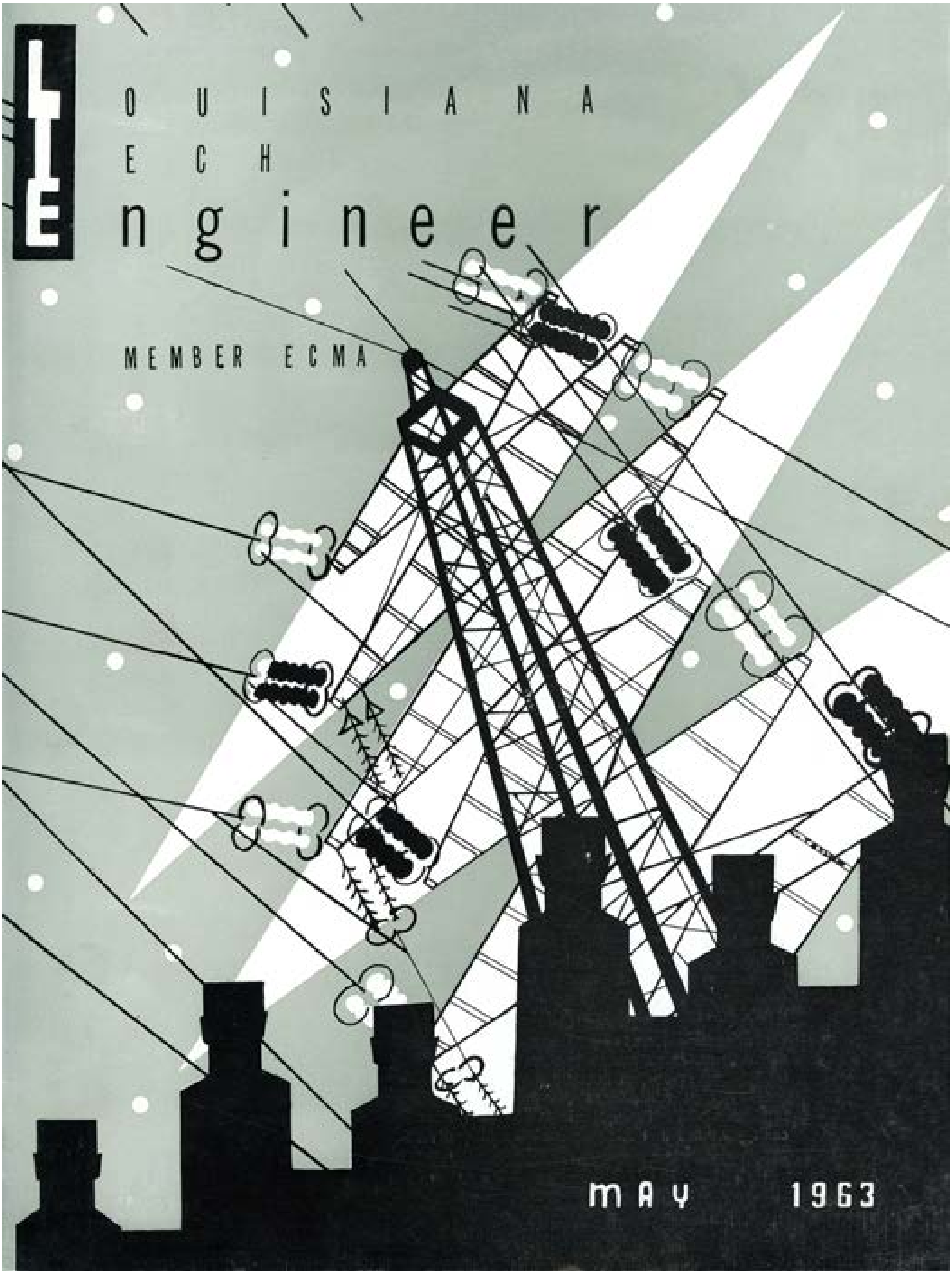
When I said civil engineering, I meant the engineers who build bridges and stuff.
Ohh, okay.
What did you think civil engineering was?
uhh...
chatter
mumble
chatter
mumble
chatter
mumble mumble
chatter
OBJECTION! HIS MATH IS WRONG!
YOUR MATH IS WRONG!
mumble
ORDER IN THE COURT!!


Master Obi-Swan?
What's wrong?
This feeling...
It's as if a million voices suddenly cried out in terror...
...and were suddenly silenced.
I mean, that happens every 120 exam, Master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THE TECH ENGINEER— SO WHAT?

Editors are all perhaps guilty of the use of trite phrases, age-worn expressions and meaningless statements concerning the future, particularly at this time of the year. With graduations abounding in high schools and colleges each spring, we seem to strive to impress upon others the trials, hardships and tribulations we have traversed in completing college. Perhaps the most obvious and yet most overlooked factor—which, if observed, would save reams of paper and weeks of editorial headaches—is that most people don't care what you have accomplished, and the few that do will never know exactly what was derived from the experience. In essence, editorial words are read, unheeded, undigested, and soon forgotten by many.

But someone always notices.

The one truth that refutes this reasoning, and that makes any effort—college, a magazine editorship, or even a smile—worthwhile is that, the masses notwithstanding, one or two or a few are cognizant of the effort.

And that makes it worthwhile.

As a member of the staff of this magazine for five years, I can truthfully admit to little more than the necessary effort throughout most of this period. Many things have been done that could have been done so much better, if I had known then. . . But is this not the way of most efforts? The word for it is a magic one—experience.

Five years is a long time, and; though perhaps somewhat shoddily done, I would welcome the chance to once again experience these responsibilities . The many embarassing and awkward positions, the stumbling situations I have experienced in these issues and their preparation are now humorous, though appalling then. But the one important thing is that they were **learning** experiences, valuable as lessons not to be forgotten. They provided for me, and for all those that have actually worked on this staff, numerous lessons that, in toto, became an education in themselves. I am thankful that I was one of the few this education was made available to, and feel an advantage that those not connected with a publication such as the **Engineer** surely could not possess.

Perhaps you have closely read the past few issues of the magazine. We have strived to achieve quality, a factor somewhat lacking in previous years. The inclusion of non-technical articles of general interest as well as more pictorial representation has been an effort to achieve readability, an evanescent factor that results from quality material. The quality of the jokes is as debatable a factor as the weather forecast. This is one point in which the magazine is rather severely censored, and considering the overall object of a college engineering magazine, perhaps justly so. The use of purely technical and often "dry" report-like material has been kept to a minimum, again with the reader in mind.

Thus we bring our personal experiences with the **Tech Engineer** to a close, stepping aside to give another the opportunity to serve you, the opportunity to do a big job better, and, perhaps most important, to learn. For that is what this publication is—a soundingboard for learning. I sincerely urge you, as engineers at Louisiana Tech, to take advantage of this opportunity to learn. All those who have an interest in this type of work, and it is varied, will find this publication to offer hard work, heartbreak—and satisfaction.

Many will say, "The **Tech Engineer**, so what?" A few have said and will continue to say, "The **Tech Engineer**—an effort, but I learned something. **Now** what?"

And that makes it worthwhile.

Ronnie Edwards

BMES
BIOMEDICAL ENGINEERING SOCIETY

The Biomedical Engineering Society (BMES) is a professional development organization designed to benefit those hoping to work in the biomedical field. However, starting this year we are hoping to expand into helping students in other fields as well. To begin, we have started improving our mentorship program to better serve our members. There are also developing plans to incorporate two new events into our yearly schedule.

The first new event is a design competition. While the competition is based in the biomedical field, it will give another project for students to add to their portfolio regardless of whether they are in mechanical engineering, biomedical engineering or some other discipline. We hope to gather a group of engineers from several disciplines to give the most versatility to our project design.

Our second goal is to implement an event called the Make-a-Thon. The Make-a-Thon is a rapid prototyping competition again focusing on medical devices. Projects collected from professors and other sources will be announced to students who will then have a week to design a product that satisfies as many criteria from an individual project as possible. Not only will this competition be open to Tech students but it also will be open to students at nearby universities. Once products have been chosen, students will then have 48 hours to design and produce a prototype.

Our mentorship program first began during the last academic year. It is designed to pair underclassmen with upperclassmen that have more experience in the biomedical engineering program. This year we are assigning a mentee to two mentors who will help them choose a concentration based on their future career goals. Mentors will also be available to help choose classes, help with homework and help with finding and applying to undergraduate research experiences, or REUs, and internships. The goal is that this program will help retain and encourage the biomedical engineering students at Tech.

AIChE

AIChE is the professional society for students seeking a Chemical Engineering degree, but any Louisiana Tech student can join! We aim to promote professional development of the members through our programs and to promote relations between students within the College of Engineering and Science. AIChE is involved on campus with both service and social events, but also offers industry tours and information sessions with companies every quarter.

ECO-CAR

BULLDOG DEVELOPMENT TEAM

In April 2018, Louisiana Tech Eco-Car brought home the Innovation and Design award from the Shell Eco-marathon in Sonoma, California. The competition hosts more than 125 teams from 9 countries across North and South America. While the innovation and design award is a routine accomplishment for our team, we also put up a fight in the off-track safety and communication competitions as well.

Since returning to campus in September, the team has made significant strides for the 2019 season. We're revolutionizing part production, becoming an officially recognized organization and building our car earlier than ever. What are our best used resources? They are none other than the Thingery shop in University Hall, machinery in Bogard Hall and a trusty Airtech Vacuum.

We spent the entirety of the 2017-2018 academic year designing the 2019 competition car digitally. This allowed the team to hit the ground running upon return to Ruston this fall. The new car will turn heads from multiple industries– not just the automotive world. The design is technical at every turn. Accounting for aerodynamics, weight reduction and driving technique is no easy task. It takes expertise from across the University to keep this team operating as such a well-oiled machine.

Our goals for 2019 include maximizing fuel efficiency, winning innovation and design, placing top three in communication and advancing to the Driver's World Championship in London. We do not know where or when our competition will be in 2019, but we ask for your various forms of support. As always, Ever Loyal Be, from the Eco-Friendly Dogs.

LOUISIANA TECH ESA

Engineering & Science Association

The Engineering and Science Association (ESA) is the official student body organization that governs the organizations for the College of Engineering and Science. The ESA serves as a liaison between students, faculty and staff at Louisiana Tech University. The purpose of this organization is to further promote interest and the spirit of friendship among College students and to acquaint prospective students and the public with the engineering and science professions.

Louisiana Tech's ESA includes all students in the College of Engineering and Science and strives to promote a sense of community amongst the students. By hosting unique events and service activities throughout the year, ESA hopes to unite everyone with a shared fascination of the STEM fields. Many exciting things on the ESA agenda are set to take place this year.

ESA is excited for the addition of several new positions and opportunities to be involved with our organization. As the student population grows, ESA is expanding to accommodate successful social events and professional development opportunities for our College. This year our Freshmen Council doubled in size, and we added a Professional Development Chair and a Service Chair. The addition of service and social committees is also in the works!

The organization is eager to introduce a new Winter Quarter event: Professional Development Week. The ESA is planning a Resume Roast with company representatives, LinkedIn 101 and Interview Prep night, all of which are aimed at helping prepare students for the Spring Career Fair. Be on the look out for more details to come!

Other upcoming events include the annual COES Christmas Party, Christmas Carnival with the Boys' and Girls' Club and exciting Freshmen Council events. With the COES organizations being so involved on and off campus this year, the COES Cup Competition is very close! ESA is looking forward to announcing the the results at our end of the year celebration, Spring Release.

If you have any questions or would like more information regarding ESA, please contact ltuesapresident@gmail.com.

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Work On Engineer's Day

MATH QUIZ

This month's mathematical mixup comes to us compliments of Mr. Lester M. Garrison, of our own math department. It is designed specifically for the rurally-inclined of our student body, and certainly should prove to be no problem for the Agricultural Engineers. Here it is:

If 6 cattle annihilate 4 acres of pasture in 25 days and 8 cattle annihilate 5 acres in 20 days, find the smallest field that can furnish eternal pasture for 10 immortal cattle.

Before tossing this one aside, just try to set up an expression for it; it definitely overrides any and all high school algebra! Oh, and don't forget, the one that turns in the first correct solution pockets that $5 bill. That's a lot of cokes, so get busy and mail your entries to The Tech Engineer, Box 185, Tech Station, Ruston, Louisiana.

Surprisingly enough, the ENGINEER'S mailbox was virtably flooded with solutions to last month's teaser. Even more surprising was that six (count 'em,6) correct answers were received! The correct solution was that the man floated 2 miles before going over the falls. First correct answer and winner of the $5 prize was submitted by C. J. Irby. Those with late but never-the-less correct solutions were: Klause Schwabe, Billy Don Bailey ,William B. Turnage, A. D. Smith, and Darwin Aulds. Congratulations, fellas!